CLAIMS

1. A method employing digital models of flow processes, the method comprising:

creating digital representations of at least two hierarchical nodes, each of the hierarchical nodes having associated therewith a respective dimensionality defining a number of dimensions of the respective hierarchical node, the respective dimensions of each of the hierarchical nodes having a defined order with respect to one another, each dimension having an associated size defining a number of members of the respective dimension;

creating digital representations of a number of hierarchical edges defining connections between at least some of the hierarchical nodes, at least a first one of the hierarchical edges defining a connection between a first and a second one of the at least two hierarchical nodes; and

for each of a number of pairs of hierarchical nodes connected by a respective shared one of the hierarchical edges, associating at least one of a number of match rules with the pair of hierarchical nodes, each of the match rules defining at least one matrix transformation between the hierarchical nodes of the respective pair, application of the matrix transformation to the members of the hierarchical nodes of the respective pair defining a resulting set of primitive nodes and primitive edges, where a first one of the number of match rules defines a first matrix transformation between the first and the second hierarchical nodes.

2. The method of claim 1, further comprising:

receiving a first set of user inputs identifying selection of a first icon representing a first hierarchical node of the at least two hierarchical nodes, and identifying a dimensionality indicating a total number of dimensions for the first hierarchical node and a size of each of the respective dimensions; and

receiving a second set of user inputs identifying selection of a first icon representing a second hierarchical node of the at least two hierarchical nodes, and identifying a dimensionality indicating a total number of dimensions for the second hierarchical node and a size of each of the respective dimensions.

3. The method of claim 2, further comprising:

receiving a third set of user inputs identifying a first icon representing an edge extending from the first to the second hierarchical nodes.

4. The method of claim 1, further comprising:

receiving a first set of user inputs identifying selection of a first icon representing the first hierarchical node of the at least two hierarchical nodes, a human-readable name of the first hierarchical node, and identifying the dimensionality indicating the total number of dimensions for the first hierarchical node, the size of each of the respective dimensions and a human-readable name for each of the dimensions.

5. The method of claim 1, further comprising:

receiving a first set of user inputs identifying selection of a first icon representing the first hierarchical node of the at least two hierarchical nodes, a human-readable name of the first hierarchical node, and identifying the dimensionality indicating the total number of dimensions for the first hierarchical node, and the order of the dimensions with respect to one another, and a size of each of the respective dimensions.

6. The method of claim 1, further comprising:

for each of the hierarchical nodes, automatically creating digital representations of a number of primitive nodes to fill in the respective dimensions, based on the number of dimensions and the size of each of the dimensions of the respective hierarchical node.

7. The method of claim 6, further comprising:

for each pair of hierarchical nodes connected by a respective shared one of the hierarchical edges, automatically creating digital representations of primitive edges between primitive nodes based on the matrix transformation defined by the match rule associated with the respective pair of hierarchical nodes.

8. The method of claim 7, further comprising:

detecting a change to at least one of the hierarchical nodes or at least one of the hierarchical edges; and

in response to the detected change, for each of the hierarchical nodes, automatically recreating digital representations of the number of primitive nodes to fill in the respective dimensions, based on the number of dimensions and the size of each of the dimensions of the respective one of the hierarchical nodes.

9. The method of claim 7, further comprising:

detecting a change to at least one of the hierarchical nodes or at least one of the hierarchical edges; and

in response to the detected change, for each of the hierarchical nodes, automatically recreating digital representations of the number of primitive nodes to fill in the respective dimensions, based on the number of dimensions and the size of each of the dimensions of the respective one of the hierarchical nodes and automatically recreating digital representations of primitive edges between primitive nodes based on the matrix transformation defined by the match rule associated with the respective pair of hierarchical nodes.

10. The method of claim 9, further comprising:

determining that a user has directed suppression of application of at least one of the match rules to at least one of the primitive nodes or at least one of the primitive edges; and

selectively suppressing of the recreating of at least one of the primitive nodes or at least one of the primitive edges based on user directed suppression of the at least one match rule to the at least one of the primitive nodes or at least one of the primitive edges.

11. The method of claim 1, further comprising:

producing a visual representation the primitive nodes and primitive edges.

12. The method of claim 11, further comprising:

producing a number of transducer drive signals corresponding to at least some of the primitive nodes and some of the primitive edges for driving a number of transducers.

13. A system for modeling highly parallel processes that operate on materials or data in which parallel paths undergo reorganizations such as combinations, and, or splitting , the system comprising:

means for creating digital representations of at least two hierarchical nodes, each of the hierarchical nodes having associated therewith a respective dimensionality defining a number of dimensions of the respective hierarchical node, the respective dimensions of each of the hierarchical nodes having a defined order with respect to one another, each dimension having an associated size defining a number of members of the respective dimension;

means for creating digital representations of a number of hierarchical edges defining connections between at least some of the hierarchical nodes, at least a first one of the hierarchical edges defining a connection between a first and a second one of the at least two hierarchical nodes; and

means for associating at least one of a number of match rules with a pair of hierarchical nodes for each of a number of pairs of hierarchical nodes connected by a respective shared one of the hierarchical edges, each of the match rules defining at

least one matrix transformation between the hierarchical nodes of the respective pair, application of the matrix transformation to the members of the hierarchical nodes of the respective pair defining a resulting set of primitive nodes and primitive edges, where a first one of the number of match rules defines a first matrix transformation between the first and the second hierarchical nodes.

14. The system of claim 13, further comprising:

a processor;

a computer-readable memory storing instructions executable by the processor, wherein the means for creating digital representations of at least two hierarchical nodes comprises a first set of instructions stored in the computer-readable memory; the means for creating digital representations of a number of hierarchical edges defining connections between at least some of the hierarchical nodes comprises a second set of instructions stored in the computer-readable memory, and the means for associating at least one of a number of match rules with a pair of hierarchical nodes for each of a number of pairs of hierarchical nodes connected by a respective shared one of the hierarchical edges comprises a third set of computer-readable instructions stored in the computer-readable memory.

15. The system of claim 13, further comprising:

a display coupled to the processor and operable to display the hierarchical nodes, the hierarchical edges, and the primitive nodes and the primitive edges.

16. The system of claim 13, further comprising:

an output port couplable to provide control signals to one or more robotic devices.

17. A computer-readable medium storing a data structure representing flow processes, the data structure comprising:

at least two hierarchical nodes, each of the hierarchical nodes having associated therewith a respective dimensionality defining a number of dimensions of the respective hierarchical node, the respective dimensions of each of the hierarchical nodes having a defined order with respect to one another, each dimension having an associated size defining a number of members of the respective dimension;

a number of hierarchical edges defining connections between at least some of the hierarchical nodes, at least a first one of the hierarchical edges defining a connection between a first and a second one of the at least two hierarchical nodes; and

a number of match rules, each of the match rules defining at least one matrix transformation between a respective pair of hierarchical nodes connected by a common one of the hierarchical edges, application of the matrix transformation to the members of the hierarchical nodes of the respective pair of hierarchical nodes define a resulting set of primitive nodes and primitive edges, at least a first one of the number of match rules defining a first matrix transformation between the first and the second hierarchical nodes.

18. The computer-readable medium of claim 17 wherein each member represents a primitive operation or a primitive material.

19. The computer-readable medium of claim 17 wherein each member represents a primitive piece of information

20. The computer-readable medium of claim 17 wherein each member represents one of a primitive operation, a primitive material, or another hierarchical node.

21. The computer-readable medium of claim 17 wherein the members are ordered along the dimension.

22. The computer-readable medium of claim 17 wherein the dimensionality of at least one of the first and the second hierarchical nodes is three and the dimensions correspond to an X-axis, a Y-axis perpendicular to the X-axis, and a Z-axis perpendicular to both the X-axis and the Y-axis.

23. The computer-readable medium of claim 17 wherein the dimensionality of at least one of the first and the second hierarchical nodes is two and the dimensions correspond to a row and a column perpendicular to the row.

24. A method employing high level constructs in the form of hierarchical nodes and hierarchical edges defining directed connections between the hierarchical nodes to represent low level details of a process flow in the form of primitive nodes and primitive connections between the primitive nodes, the method comprising:

for each of a number of hierarchical nodes, automatically creating a number of primitive nodes to at least partially fill at least one Cartesian dimension of the respective one of hierarchical nodes; and

automatically creating of a number of primitive edge connections between the automatically created primitive nodes based on a match rule associated with a connected pair the hierarchical nodes, the match rule defining at least one matrix transformation between the hierarchical nodes of the connected pair of hierarchical nodes.

25. The method of claim 24, further comprising:

associating properties with at least some of the primitive nodes, the properties associated with the primitive nodes corresponding to a property assigned to respective dimensions of the hierarchical nodes from which the primitive node is defined via the respective match rule.

26. The method of claim 24 wherein a first hierarchical node corresponds to a first material, a second hierarchical node corresponds to a second material, and a third hierarchical node corresponds to an operation to be performed on the first and the second material, a first edge connects the first hierarchical node to the third hierarchical node and a second edge connects the second hierarchical node to the third hierarchical node.

27. The method of claim 26 wherein automatically creating a number of primitive nodes to at least partially fill at least one Cartesian dimension of the respective one of hierarchical nodes comprises creating a number of primitive nodes representing rows of the first hierarchical node, creating a number of primitive nodes representing columns of the second hierarchical node, and creating a number of rows and columns of primitive nodes representing the third hierarchical node, the number of rows representing the third hierarchical node matching a number of rows in the first hierarchical node and the number of columns representing the third hierarchical node matching a number of columns in the second hierarchical node.

28. The method of claim 27 wherein automatically creating of a number of primitive edge connections between the automatically created primitive nodes based on a match rule associated with a connected pair the hierarchical nodes comprises creating an edge connection from each of a number of primitive node representing respective rows in the first hierarchical node to each of the primitive nodes in a respective row of the third hierarchical node, and creating an edge connection from each of a number of primitive nodes representing respective columns in the second hierarchical node to each of the primitive nodes in a respective column of the third hierarchical node.